IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Patent Application

Appellant(s): Dennis R. Morgan
Docket No: Morgan 13
Serial No.: 10/775,911
Filing Date: February 10, 2004
Group: 2613
Examiner: Nathan M. Curs

Title: Method and Apparatus for Two-Port Allpass Compensation of Polarization Mode Dispersion

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APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellant hereby appeals the final rejection, dated January 5, 2010, of claims 1-5, 7-11 and 13-22 of the above-identified patent application.

REAL PARTY IN INTEREST

The present application is assigned to Lucent Technologies Inc., as evidenced by an assignment recorded on February 10, 2004 in the United States Patent and Trademark Office at Reel 014984, Frame 0141. The assignee, Lucent Technologies Inc., is the real party in interest.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

STATUS OF CLAIMS

The present application was filed on February 10, 2004 with claims 1 through 22. Claim 18 was objected to due to an indicated informality. Claims 1-4 and

13-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al. ("Optical Filter Architecture for Approximating Any 2x2 Unitary Matrix," Optics Letters, vol. 28, no. 17, April 1, 2003, pages 534-536) in view of MacFarlane et al. (United States Patent Number 6,687,461). Claims 5 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al., in view of MacFarlane et al. as applied to claims 4 and 16 respectively above, and further in view of Applicant's Admitted Prior Art. Claims 7-10 and 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al., and in view of Eyal et al. ("Design of Broad Band PMD Compensation Filters," IEEE Photonics Technology Letters, vol. 14, no. 8, August 2002, pages 1088-1090). Claims 11 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al. in view of Eyal et al. as applied to claims 7 and 18 respectively above, and further in view of Applicant's Admitted Prior Art. The Examiner has indicated that claims 6 and 12 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Claims 1, 7, 13 and 18 are being appealed.

STATUS OF AMENDMENTS

There have been no amendments filed subsequent to the final rejection.

SUMMARY OF CLAIMED SUBJECT MATTER

Independent claim 1 requires a method for compensating for polarization mode dispersion (FIG. 4 and page 2, lines 18-19) in an optical fiber communication system (FIG. 2 and page 3, lines 3-25), comprising the steps of: reducing said polarization mode dispersion using a cascade of all-pass filters (FIG. 4, 420 and 440 and page 2, lines 18-19; page 4, line 30, to page 4, line 4); and adjusting coefficients of said all-pass filters using a least mean square algorithm (page 7, lines 16-24).

Independent claim 7 requires a method for compensating for polarization mode dispersion (FIG. 4 and page 2, lines 18-19) in an optical fiber communication system (FIG. 2 and page 3, lines 3-25), comprising the steps of: reducing said polarization mode dispersion using a cascade of all-pass filters (FIG. 4, 420 and 440 and

page 2, lines 18-19; page 4, line 30, to page 4, line 4); and adjusting coefficients of said all-pass filters using a Newton algorithm (page 7, lines 28-31).

Independent claim 13 requires a polarization mode dispersion compensator (FIG. 1: 400 and FIG. 6; page 2, lines 18-19) in an optical fiber communication system (FIG. 2 and page 3, lines 3-25), comprising: a cascade of all-pass filters (FIG. 4, 420 and 440 and page 2, lines 18-19; page 4, line 30, to page 4, line 4) having coefficients that are adjusted using a least mean square algorithm (page 7, lines 16-24).

Independent claim 18 requires a polarization mode dispersion compensator (FIG. 1: 400 and FIG. 6; page 2, lines 18-19) in an optical fiber communication system (FIG. 2 and page 3, lines 3-25), comprising: a cascade of all-pass filters (FIG. 4, 420 and 440 and page 2, lines 18-19; page 4, line 30, to page 4, line 4) having coefficients that are adjusted using a Newton algorithm (page 7, lines 28-31).

STATEMENT OF GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Claim 18 was objected to due to an indicated informality. Claims 1-4 and 13-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al. in view of MacFarlane et al. Claims 5 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al., in view of MacFarlane et al. as applied to claims 4 and 16 respectively above, and further in view of Applicant's Admitted Prior Art. Claims 7-10 and 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al., and in view of Eyal et al. Claims 11 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Madsen et al. in view of Eyal et al. as applied to claims 7 and 18 respectively above, and further in view of Applicant's Admitted Prior Art.

ARGUMENT

Formal Objections

Claim 18 was objected to because the phrase "adjusting step" should be "adjustment" for consistency.

Appellant maintains that the cited phrase "adjusting step" is consistent with the term "adjusted" and explicitly addresses the previous section 101 rejection by requiring that a *step* is performed by a device.

Appellant respectfully requests that the formal objections be withdrawn,

<u>Section 103 Rejections</u>

Independent claims 1 and 13 were rejected under 35 U.S.C. §103(a) as being unpatentable over Madsen in view of MacFarlane et al. With regard to claim 1, for example, the Examiner asserts that Madsen discloses a method for compensating for polarization mode dispersion in an optical fiber communication system (citing Figures 1-3), comprising the steps of: reducing said polarization mode dispersion using a cascade of all-pass filters (citing Abstract and Fig. 3); and adjusting coefficients of said all-pass filters (citing page 535, left column, first complete par.).

The Examiner acknowledges that Madsen adjusts the coefficients using a least square algorithm (citing page 535, left column, first complete par.), but does **not** disclose adjusting the coefficients using a *least mean square algorithm*. The Examiner asserts, however, that MacFarlane et al. teach a system related to Madsen including optical filters for compensating for polarization mode dispersion having adjusted coefficients (col. 1, lines 28-53, col. 2, lines 51-65 and col. 5, lines 23-42). The Examiner further asserts that MacFarlane et al. teach that the filter coefficients can be adjusted using a variety of minimization algorithms including a least squares algorithm or an LMS algorithm (col. 19, lines 16-22).

Appellant notes that independent claims 1 and 13 require adjusting coefficients of said <u>two-port</u> all-pass filters using a *least mean square algorithm*. Support for this limitation can be found, for example, in FIGS. 5 and 6 and the associated text wherein the cross-coupled box T, as defined in equation (1), defines a two-port network since the two channels are appropriately coupled. Appellant acknowledges that the use of the LMS algorithm for adapting FIR filters and/or *single-channel* all-pass filters is both well-known and straightforward. Appellant strongly asserts, however, that it would *not* have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of <u>*two-port*</u> *all-pass filters*. It is *not* known to adapt <u>*two-port*</u> *all-pass filters* using the LMS algorithm. Furthermore, <u>the adaptation equations for FIR filters</u>

and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*. Thus, a person of ordinary skill in the art would *not* recognize how to adapt *two-port all-pass filters* using the LMS algorithm.

In the Response to Arguments section of the final Office Action, the Examiner asserts that Appellant has not provided any reasoning or evidence in support of the statement that the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*.

Appellant has previously submitted a paper entitled "Adaptive Algorithms for Two-Port Allpass Compensation of Polarization Mode Dispersion" dated September 23, 2002 and authored by Appellant. As described in the abstract, the cited paper describes the derivation of a Newton-type algorithm, for example, in the context of a two-port structure consisting of multiple cascades of allpass filters and directional couplers. Since the adaptation equations for FIR filters and/or *single-channel* all-pass filters are not applicable for adapting *two-port all-pass filters* using the LMS algorithm or the Newton algorithm, section III describes a derivation of the equations that are applicable for adapting *two-port all-pass filters* using the LMS algorithm or the Newton algorithm. Appellant maintains that the derivation of the cited equations would not be obvious to a person of ordinary skill in the art.

In the Advisory Action, the Examiner asserts that the "do not apply" assertion only implies some kind of rule-of-thumb or common practice known to Applicant for LMS algorithms, but it is not evidence that the substitution cannot be made.

Contrary to the Examiner's assertion, Appellant maintains that the statement that "the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*" is not merely "some kind of rule-of-thumb or common practice"; rather, it is an explicit statement that the adaptation equations for FIR filters and/or *single-channel* all-pass filters are *not* useful for adapting *two-port all-pass filters*, as evidenced by the cited paper.

In further support of Appellant's position that it would *not* have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of *two-port all-pass filters*, Appellant notes that, for most applications, a two-port all-pass filter is *not* advantageous and an FIR filter is much easier to implement.

Thus, persons of ordinary skill in the art are inclined to use FIR filters and, due to the complexity of an implementation with *two-port all-pass filters*, would *not* be motivated to utilize a two-port all-pass filter in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*, the combination suggested by the Examiner *would not work*.

In the Response to Arguments section of the final Office Action, the Examiner asserts that the above argument is not persuasive because two-pass all-port filters are expressly disclosed by Madsen. Appellant maintains, however, that in light of Madsen and MacFarlane, a person of ordinary skill in the art would select an FIR filter due to the complexity of utilizing *two-port all-pass filters* and the fact that the combination suggested by the Examiner *would not work*.

Similarly, Appellant notes that independent claims 7 and 18 require adjusting coefficients of said two-port all-pass filters using a Newton algorithm. Support for this limitation can be found, for example, in FIGS. 5 and 6 and the associated text wherein the cross-coupled box T, as defined in equation (1), defines a two-port network since the two channels are appropriately coupled. Appellant acknowledges that the use of the Newton algorithm for adapting FIR filters and/or *single-channel* all-pass filters is both well-known and straightforward. Appellant strongly asserts, however, that it would *not* have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of *two-port all-pass filters*. It is *not* known to adapt *two-port all-pass filters* using the Newton algorithm. Furthermore, the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*. Thus, a person of ordinary skill in the art would *not* recognize how to adapt *two-port all-pass filters* using the Newton algorithm.

In further support of Appellant's position that it would *not* have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of *two-port all-pass filters*, Appellant notes that for most applications, a two-port all-pass filter is *not* advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with *two-port all-pass filters*, would *not* be motivated

to utilize a *two-port all-pass filter* in combination with a Newton algorithm in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters and/or *single-channel* all-pass filters do *not* apply to the adaptation of *two-port all-pass filters*, the combination suggested by the Examiner *would not work*. Thus, a person of ordinary skill in the art would be motivated to utilize a FIR filter.

In the Response to Arguments section of the final Office Action, the Examiner asserts that McFarlane teaches that filtering is based on the need to compensate for three types of dispersion, including polarization dispersion, which is PMD (col. 1, lines 43-46). Appellant notes that the text cited by the Examiner describes a "need" recited in the Background section of McFarlane. There is *no* disclosure or suggestion that the invention of McFarlane fulfills this need. Contrary to the Examiner's assertion, while MacFarlane et al. may address optical filtering and polarization, there is *no* disclosure or suggestion to *compensate for polarization mode dispersion*.

The Examiner also reiterates that Eyal teaches adjusting coefficients using a Newton algorithm since Eyal teaches "using a Newton algorithm to optimize variables in equations for producing optimized filter coefficients."

Contrary to the Examiner's assertion, Eyal does **not** teach that filter coefficients are adjusted using a Newton algorithm in the discussion on page 1089, end of first par. of right column. While the Newton algorithm is discussed in this passage, it is **not** in connection with the adjustment of filter coefficients. Rather, the discussion at page 1089, end of first par. of right column, is directed to correction of *optimization variables*. The *optimization variables* are clearly distinct from the coefficients in the preceding discussion in the same paragraph.

In the Response to Arguments section of the final Office Action, the Examiner asserts that the optimization variables of Eyal are effectively filter coefficients for the compensating filter, regardless of Eyal's use of the term "coefficient" for other designations. Appellant finds no rationale in apparently disregarding Eyal's teachings regarding the term "coefficient."

Appellant has already acknowledged that the use of the Newton algorithm for adapting FIR filters is both well-known and straightforward. As noted above, Appellant strongly asserts, however, that it would not have been obvious to a person of

ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters. It is not known to adapt two-port all-pass filters using the Newton algorithm. Furthermore, the adaptation equations for FIR filters do *not* apply to the adaptation of a two-port all-pass filter. Thus, a person of ordinary skill in the art would not recognize how to adapt *two-port all-pass filters* using the Newton algorithm.

Also, contrary to the Examiner's assertion, while MacFarlane et al. may address optical filtering and polarization, there is no disclosure or suggestion to *compensate for polarization mode dispersion*.

Thus, MacFarlane et al. does not disclose or suggest the step of "reducing said polarization mode dispersion." In addition, MacFarlane et al. does not disclose or suggest that the polarization mode dispersion is reduced "using a cascade of two-port all-pass filters," and the Examiner has not alleged that MacFarlane et al. discusses all-pass filters.

In addition, again contrary to the Examiner's assertion, MacFarlane et al. does **not** teach that the filter coefficients can be adjusted using a variety of minimization algorithms including an LMS algorithm (citing col. 19, lines 16-22). *While the LMS algorithm is discussed at col. 19, lines 16-22, it is* ***not*** *in connection with the adjustment of filter coefficients*. Rather, the discussion at col. 19, lines 16-22 is directed to adjusting "the gains on an on-going basis (of a network traffic router) to minimize error correction coding related error rates" (lines 11-13). It is further noted that as "the gains are adjusted, the control signal values in the look-up tables are also preferably updated as well." *Id*. at lines 14-16. Appellant can find ***no*** disclosure or suggestion in MacFarlane et al. to adjust the ***coefficients of a filter*** (especially a two-port all-pass filter) using the LMS algorithm (and especially in the context of reducing polarization mode dispersion).

In the Response to Arguments section of the final Office Action, the Examiner asserts that the LMS disclosure is tied to adaptive signal processing algorithms for adjusting the filters to minimize errors, which includes those caused by PMD in light of col. 1, lines 43-46. Appellant reiterates that the text cited by the Examiner describes a "need" recited in the Background section of McFarlane. There is *no* disclosure or suggestion that the disclosed LMS algorithm is in connection with the adjustment of filter coefficients.

Appellant has previously acknowledged that the use of the LMS algorithm for adapting FIR filters is both well-known and straightforward. As noted above, Appellant strongly asserts, however, that it would *not* have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of two-port all-pass filters. It is not known to adapt two-port all-pass filters using the LMS algorithm. Furthermore, the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter. Thus, a person of ordinary skill in the art would not recognize how to adapt *<u>two-port</u> all-pass filters* using the LMS algorithm.

An Examiner must establish "an apparent reason to combine … known elements." *KSR International Co. v. Teleflex Inc. (KSR)*, 550 U.S. ___, 82 USPQ2d 1385 (2007). Here, the Examiner states that it would have been obvious to implement the LMS adaptation of MacFarlane et al. in the system of Madsen as an "engineering design choice" of another way to provide the minimization function. As discussed hereinafter, the use of the LMS algorithm in the manner suggested only by the present invention is more than a mere design choice. Again, any discussion of adaptation using the LMS algorithm is not in the context of adjusting the ***coefficients of a filter*** (especially a two-port all-pass filter in the context of reducing polarization mode dispersion).

In the Response to Arguments section of the final Office Action, the Examiner asserts that Appellant does not provide reasoning or evidence against the use of LMS over LS as a design choice. As noted above, the adaptation equations for FIR filters do *not* apply to the adaptation of a two-port all-pass filter. Moreover, a person of ordinary skill in the art would not recognize how to adapt *<u>two-port</u> all-pass filters* using the LMS algorithm. Thus, the use of the LMS algorithm in the manner suggested only by the present invention is not a mere design choice.

Appellant is claiming a new technique for compensating for polarization mode dispersion in an optical fiber communication system *by* using a cascade of two-port all-pass filters; and adjusting coefficients of said two-port all-pass filters *using a least mean square algorithm.*

There is *no* suggestion in Madsen or in MacFarlane et al., alone or in combination, to adjust coefficients of a cascade of two-port all-pass filters *using a least mean square algorithm.*

In further support of Appellant's position that it would not have been obvious to a person of ordinary skill in the art to apply the LMS algorithm to the adaptation of two-port all-pass filters, Appellant notes that for most applications, an all-pass filter is *not* advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the complexity of an implementation with a two-port all-pass filter, would not be motivated to utilize a two-port all-pass filter in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter, the combination suggested by the Examiner *would not work*.

The above-noted complexity of an implementation with a two-port all-pass filter also strongly contradicts the Examiner's contention that the combination is motivated by a desire to "quickly and accurately compensate (for) dispersion." In addition, this strong inclination by those of ordinary skill towards the use of FIR filters makes the proposed combination more than a mere "substitution" of one minimization algorithm for another.

This information known to those of ordinary skill in the art ***teaches away*** from the present invention. The *KSR* Court discussed in some detail United States v. Adams, 383 U.S. 39 (1966), stating in part that in that case, "[t]he Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." (KSR Opinion at p. 12). Thus, there is no reason to make the asserted combination/modification.

In the Response to Arguments section of the Office Action, the Examiner notes, in regard to Appellant's argument that "the adaptation equations for FIR filters do not apply to the adaptation of an all-pass filter," that the rejected claims do not recite particular equations.

Appellant notes that the cited argument was presented to illustrate that the Examiner's proposed combination of references was *not* valid because the combination suggested by the Examiner *would not work*. Appellant's argument is valid regardless of whether the equations are recited in the claims.

In the Advisory Action, the Examiner asserts that the document submitted in the IDS of March 5, 2010 establishes that the subject matter of the claims was "known by others" as of September 2002."

As described in the abstract, the cited paper describes the derivation of a *Newton-type* *algorithm*, for example, in the context of a two-port structure consisting of multiple cascades of allpass filters and directional couplers. The cited paper does *not* disclose or suggest, however, the *claimed method and device* *for compensating for polarization mode dispersion in an optical fiber communication system and for compensating for polarization mode dispersion in an optical fiber communication system.*

Claims 7 and 18

Independent claims 7 and 18 were rejected under 35 U.S.C. §103(a) as being unpatentable over Madsen in view of Eyal et al. With regards to claims 7 and 18, the Examiner again asserts that Madsen discloses a method for compensating for polarization mode dispersion in an optical fiber communication system (citing Figures 1-3), comprising the steps of: reducing said polarization mode dispersion using a cascade of all-pass filters (citing Abstract and Fig. 3); and adjusting coefficients of said all-pass filters (citing page 535, left column, first complete paragraph).

The Examiner acknowledges that Madsen adjusts the coefficients using a least square algorithm (citing page 535, left column, first complete par.), but does **not** disclose adjusting the coefficients using a *Newton algorithm*. The Examiner asserts, however, that various optimization algorithms are known and that Eyal et al. teach a system including optical filters for compensating for polarization mode dispersion having adjusted coefficients (page 1088) and that the filter coefficients are adjusted using a Newton algorithm (citing page 1089, end of first par. of right column).

Eyal et al., however, do not disclose or suggest that the polarization mode dispersion is reduced "using a cascade of two-port all-pass filters," and the Examiner has not alleged that Eyal et al. discusses all-pass filters.

In addition, contrary to the Examiner's assertion, Eyal et al. does **not** teach that filter coefficients are adjusted using a Newton algorithm in the discussion on page 1089, end of first par. of right column. While the Newton algorithm is discussed in this

passage, it is **not** in connection with the adjustment of filter coefficients. Rather, the discussion at page 1089, end of first par. of right column, is directed to correction of *optimization variables*. The *optimization variables* are clearly distinct from the coefficients in the preceding discussion in the same paragraph.

Appellant has already acknowledged that the use of the Newton algorithm for adapting FIR filters is both well-known and straightforward. As noted above, Appellant strongly asserts, however, that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters. It is not known to adapt two-port all-pass filters using the Newton algorithm. Furthermore, the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter. Thus, a person of ordinary skill in the art would *not* recognize how to adapt *two-port all-pass filters* using the Newton algorithm.

An Examiner must establish "an apparent reason to combine … known elements." *KSR International Co. v. Teleflex Inc. (KSR)*, 550 U.S. ___, 82 USPQ2d 1385 (2007). Here, the Examiner merely states that it would have been obvious to implement the Newton adaptation of Eyal et al. in the system of Madsen as an "engineering design choice" of another way to provide the minimization function. As discussed hereinafter, the use of the Newton algorithm in the manner suggested only by the present invention is more than a mere design choice.

Appellant is claiming a new technique for compensating for polarization mode dispersion in an optical fiber communication system *by* using a cascade of two-port all-pass filters; and adjusting coefficients of said two-port all-pass filters *using a Newton algorithm*.

There is *no* suggestion in Madsen or in Eyal et al., alone or in combination, to adjust coefficients of a cascade of two-port all-pass filters *using a Newton algorithm*.

In further support of Appellant's position that it would not have been obvious to a person of ordinary skill in the art to apply the Newton algorithm to the adaptation of two-port all-pass filters, Appellant notes that for most applications, an all-pass filter is not advantageous and an FIR filter is much easier to implement. Thus, persons of ordinary skill in the art are inclined to use FIR filters and due to the

complexity of an implementation with a two-port all-pass filter, would not be motivated to utilize a two-port all-pass filter, in the manner suggested by the Examiner. In addition, since the adaptation equations for FIR filters do not apply to the adaptation of a two-port all-pass filter, the combination suggested by the Examiner *would not work*.

The above-noted complexity of an implementation with a two-port all-pass filter also strongly contradicts the Examiner's contention that the combination is motivated by a desire to "quickly and accurately compensate (for) dispersion." In addition, this strong inclination by those of ordinary skill towards the use of FIR filters makes the proposed combination more than a mere "substitution" of one minimization algorithm for another.

This information known to those of ordinary skill in the art ***teaches away*** from the present invention. The *KSR* Court discussed in some detail United States v. Adams, 383 U.S. 39 (1966), stating in part that in that case, "[t]he Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." (KSR Opinion at p. 12). Thus, there is no reason to make the asserted combination/modification.

Appellant respectfully requests the withdrawal of the rejection of independent claims 1, 7, 13 and 18.

The rejections of the cited claims under section 103 in view of Madsen et al., MacFarlane et al., Applicant's Admitted Prior Art, and Eyal et al., alone or in any combination, are therefore believed to be improper and should be withdrawn. The remaining rejected dependent claims are believed allowable for at least the reasons identified above with respect to the independent claims. The Examiner has already indicated that Claims 6 and 12 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

All of the pending claims, i.e., claims 1-22, are in condition for allowance and such favorable action is earnestly solicited.

If any outstanding issues remain, or if the Examiner or the Appeal Board has any further suggestions for expediting allowance of this application, the Examiner

and the Appeal Board are invited to contact the undersigned at the telephone number indicated below.

The attention of the Examiner and the Appeal Board to this matter is appreciated.

Respectfully submitted,

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Date: April 30, 2010

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APPENDIX

1. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:

reducing said polarization mode dispersion using a cascade of two-port all-pass filters; and

adjusting coefficients of said two-port all-pass filters using a least mean square algorithm, wherein said adjusting step is performed by a device.

2. The method of claim 1, wherein said cascade of two-port all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

3. The method of claim 1, wherein said coefficient values are adjusted to minimize a cost function.

4. The method of claim 1, further comprising the step of measuring said polarization mode dispersion in a received optical signal.

5. The method of claim 4, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.

6. The method of claim 1, wherein said cascade of two-port all-pass filters comprises a first all-pass filter A having a vector a comprised of P coefficients and a second all-pass filter B having a vector b comprised of Q coefficients and wherein said least mean square algorithm adjusts said coefficients as follows:

$$\mathrm{w}(n+1) = \mathrm{w}(n) - \mu\nabla(J),$$

where n indicates the current iteration number and w is a composite coefficient vector defined as:

$$\mathrm{w} = \begin{bmatrix} \mathrm{a} \\ \mathrm{b} \end{bmatrix}, \ \nabla(J) \equiv \left[\frac{\partial J}{\partial \mathrm{a}^T} \frac{\partial J}{\partial \mathrm{b}^T} \right]^T$$

is the $(P+Q)\times 1$ complex gradient of J with respect to w and T indicates a transpose operation, and

$$\frac{\partial J}{\partial \mathrm{a}^T} \equiv \left[\frac{\partial J}{\partial a_1} \quad \frac{\partial J}{\partial a_2} \quad \cdots \quad \frac{\partial J}{\partial a_P}\right], \text{ and}$$

$$\frac{\partial J}{\partial \mathrm{b}^T} \equiv \left[\frac{\partial J}{\partial b_1} \quad \frac{\partial J}{\partial b_2} \quad \cdots \quad \frac{\partial J}{\partial b_Q}\right].$$

7. A method for compensating for polarization mode dispersion in an optical fiber communication system, comprising the steps of:

reducing said polarization mode dispersion using a cascade of two-port all-pass filters; and

adjusting coefficients of said two-port all-pass filters using a Newton algorithm, wherein said adjusting step is performed by a device.

8. The method of claim 7, wherein said cascade of two-port all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

9. The method of claim 7, wherein said coefficient values are adjusted to minimize a cost function.

10. The method of claim 7, further comprising the step of measuring said polarization mode dispersion in a received optical signal.

11. The method of claim 10, wherein said measuring step employs a tunable narrowband optical filter to render information from energy detector measurements.

12. The method of claim 7, wherein said cascade of two-port all-pass filters comprises a first all-pass filter A having a vector a comprised of P coefficients and a second all-pass filter B having a vector b comprised of Q coefficients and wherein said Newton algorithm adjusts said coefficients as follows:

$$w(n+1) = w(n) - \mu H^{-1}\nabla(J)$$

where n indicates the current iteration number and w is a composite coefficient vector defined as:

$$w = \begin{bmatrix} a \\ b \end{bmatrix}, \ \nabla(J) \equiv \begin{bmatrix} \frac{\partial J}{\partial a^T} & \frac{\partial J}{\partial b^T} \end{bmatrix}^T$$

$\frac{\partial J}{\partial a^T} \equiv \begin{bmatrix} \frac{\partial J}{\partial a_1} & \frac{\partial J}{\partial a_2} & \cdots & \frac{\partial J}{\partial a_P} \end{bmatrix}$, is the $(P+Q)\times 1$ complex gradient of J with respect to w, T indicates a transpose operation and, a Hessian matrix, H, is defined as follows:

$$H = \frac{\partial^2 J}{\partial w \partial w^T} = \begin{bmatrix} \frac{\partial^2 J}{\partial a \partial a^T} & \frac{\partial^2 J}{\partial a \partial b^T} \\ \frac{\partial^2 J}{\partial b \partial a^T} & \frac{\partial^2 J}{\partial b \partial b^T} \end{bmatrix} \text{and}$$

$$\frac{\partial J}{\partial b^T} \equiv \begin{bmatrix} \frac{\partial J}{\partial b_1} & \frac{\partial J}{\partial b_2} & \cdots & \frac{\partial J}{\partial b_Q} \end{bmatrix}.$$

13. A polarization mode dispersion compensator in an optical fiber communication system, comprising:

a cascade of two-port all-pass filters having coefficients that are adjusted using a least mean square algorithm, wherein said adjustment is performed by a device.

14. The polarization mode dispersion compensator of claim 13, wherein said cascade of two-port all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

15. The polarization mode dispersion compensator of claim 13, wherein said coefficient values are adjusted to minimize a cost function.

16. The polarization mode dispersion compensator of claim 13, further comprising a polarization mode dispersion measuring device for measuring said polarization mode dispersion in a received optical signal.

17. The polarization mode dispersion compensator of claim 16, wherein said polarization mode dispersion measuring device employs a tunable narrowband optical filter to render information from energy detector measurements.

18. A polarization mode dispersion compensator in an optical fiber communication system, comprising:

a cascade of two-port all-pass filters having coefficients that are adjusted using a Newton algorithm, wherein said adjusting step is performed by a device.

19. The polarization mode dispersion compensator of claim 18, wherein said cascade of two-port all-pass filters comprises a two-channel structure consisting of multiple cascades of all-pass filters and directional couplers.

20. The polarization mode dispersion compensator of claim 18, wherein said coefficient values are adjusted to minimize a cost function.

21. The polarization mode dispersion compensator of claim 18, further comprising a polarization mode dispersion measuring device for measuring said polarization mode dispersion in a received optical signal.

22. The polarization mode dispersion compensator of claim 21, wherein said polarization mode dispersion measuring device employs a tunable narrowband optical filter to render information from energy detector measurements.

EVIDENCE APPENDIX

Dennis R. Morgan, "Adaptive Algorithms for Two-Port Allpass Compensation of Polarization Mode Dispersion", IEEE Trans. Signal Processing, September, 2002.

RELATED PROCEEDINGS APPENDIX

There are no known decisions rendered by a court or the Board in any proceeding identified pursuant to paragraph (c)(1)(ii) of 37 CFR 41.37.